REMARKS

Claim 1 has been amended to incorporate the recitations of claims 2 and 9, and claims 2 and 9 have been canceled. In view of the amendment of the preamble of claim 1 based on the incorporation of the recitations of claim 9 into claim 1, the preamble of each of claims 5-8 has been amended. The dependency of claims 10 and 11 has been amended in view of the cancellation of claim 9.

Entry of the above amendment is respectfully requested.

Obviousness Rejections

Claims 1, 2, 5 and 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Abe (JP 2002-050413, machine translation previously provided) in view of Granqvist et al. (US 20050238550) and Ohya et al. (US 6629833). Claims 1, 5, 8-9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura (US 6291763) in view of Granqvist et al. (US 20050238550) and Ohya et al. (US 6629833). Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura (US 6291763) in view of Granqvist et al. (US 20050238550) and Ohya et al. (US 6629833) as applied to claim 1, and further in view of Tamai et al. (US 20020037399).

Applicants respectfully submit that the invention as recited in the amended claims is not obvious over the cited art combinations, and request reconsideration and withdrawal of these rejections in view of the following remarks.

The present invention

The present invention is characterized by at least the feature that the transparent conductive layer has a surface tension of 65 mN/m or greater. In this regard, Applicant notes

that as the surface tension becomes greater, the transparent conductive layer has excellent adhesion for the porous semiconductor layer, and then the photogenerating efficiency becomes greater (see Table 2 on page 32 in the present application).

Also, Applicants note that the surface tension of a transparent conductive layer without activation of the surface is less than 40 mN/m, as shown in Comparative Example 3 in Table 2 in the present application.

Applicants further note that the transparent conductive layer having the surface tension of 65 mN/m or greater can be achieved by a method of activation by plasma treatment or other treatments mentioned at page 10, line 18 - page 11, line 6 of the specification.

Additionally, Applicants submit that it is possible to provide an electrode for a dye-sensitized solar cell which has excellent adhesion between the transparent conductive layer and the porous semiconductor layer by having the feature that the transparent conductive layer has a surface tension of 65 mN/m or greater.

Cited documents

(a) JP2002-050413 (Abe et al)

Abe et al discloses a laminate film for a dye-sensitized solar cell containing a polyester film (PET) and a transparent conductive layer (ITO).

Meanwhile, the surface tension of the transparent conductive layer disclosed in this document does not satisfy the feature that the transparent conductive layer has a surface tension of 65 mN/m or greater, as can be seen from Comparative Example 3 in the present application (surface tension of the ITO transparent conductive layer without activation of the surface is 32.3 mN/m).

Also, Abe et al is silent as to improving an adhesion between the transparent conductive layer and the porous semiconductor layer.

Abe et al also fails to disclose the difference in the heat shrinkage rates in the lengthwise direction and widthwise direction of the film upon heating for 10 minutes at 200°C.

(b) US 6629833 (Ohya et al)

The invention of this document relates to transparent conductive films using plastic films and to touch panels.

Ohya discloses a transparent conductive thin film having a surface tension of 35 to 60 dyne/cm.

On the other hand, Ohya's invention is mainly used in touch panels, so the objective of the surface tension property of the transparent conductive film is strong adhesion to silver paste when used in touch panels. In contrast, the objective of the surface tension property of the transparent conductive layer in the present invention is excellent adhesion between the transparent conductive layer and the porous semiconductor layer.

Therefore, the kind of the adjacent material is different from the present invention.

Moreover, the silver paste is used in a trace amount, so the silver paste does not form a layer on the transparent conductive layer, but usually forms a portion on the transparent conductive layer as measured in the shape of mesh in the measurement of adhesion properties to silver paste (measurement (9)) in Ohya's invention.

Concerning the shape of the porous semiconductor in the present invention, which is laminated on the transparent conductive layer, the shape is a planar state, so the shape of the adjacent material is different.

Moreover, Applicants note that the Examiner indicates in the final rejection that it would have been obvious to one of ordinary skill in the art at the time of the invention to provide a surface tension of 35-60 dyne/cm to the transparent conductive film of Abe to provide a strong adhesion between the adjacent layers as taught by Ohya.

Also, the Examiner indicates in the Response to Arguments section (see pages 11-12 of the Office Action in particular) that the shape of the porous semiconductor is not claimed and further, it is taken that the surface tension of the layer is a characteristic of the layer itself and is not affected by the composition of the adjacent layer.

In response, Applicants submit that the shape of the porous semiconductor is now claimed recited in amended claim 1 as the porous semiconductor layer. Also, Applicant submits that the adhesion characteristics between the transparent conductive layer and the adjacent porous semiconductor layer are affected by the composition of the adjacent layer and the surface tension of the transparent conductive layer.

Furthermore, in the present invention, the effect of more than 3% photogenerating efficiency as a dye-sensitized solar cell is obtained by having a surface tension of transparent conductive layer of 65 mN/m or greater, ***which is beyond the range Ohya teaches.***

Therefore, from the difference of i) the shape of the transparent conductive layer and ii) the greater surface tension of the transparent conductive layer than Ohya, Applicants believe the present invention is not obvious over the cited art.

(c) US 6291763 (Nakamura et al)

Nakamura et al discloses a laminate film for a dye-sensitized solar cell containing a polymer film including polyester layer and a transparent conductive layer.

Meanwhile, the surface tension of the transparent conductive layer disclosed in this document does not satisfy the feature that the transparent conductive layer has a surface tension of 65 mN/m or greater, as can be seen from Comparative Example 3 of the present application (surface tension of the ITO transparent conductive layer without activation of the surface is 32.3 mN/m).

Also, Nakamura et at is silent as to improving an adhesion between the transparent conductive layer and the porous semiconductor layer.

Nakamura et al also fails to disclose the difference in the heat shrinkage rates in the lengthwise direction and widthwise direction of the film upon heating for 10 minutes at 200°C.

(e) US 2002/0037399 (Tamai et al)

Tamai et al discloses a laminate film containing a polyester film (PET) and a transparent conductive layer (ITO).

The surface tension of the transparent conductive layer disclosed in this document does not satisfy the feature that the transparent conductive layer has a surface tension of 65 mN/m or greater, as can be seen from Comparative Example 3 of the present application (surface tension of the ITO transparent conductive layer without activation of the surface is 32.3 mN/m).

Also, Tamai et al is silent as to improving an adhesion between the transparent conductive layer and the porous semiconductor layer.

Tamai et al also fails to disclose the difference in the heat shrinkage rates in the lengthwise direction and widthwise direction of the film upon heating for 10 minutes at 200°C.

Claim Rejections under § 103(a)

Concerning the surface tension property (i.e., the feature that the transparent conductive layer has a surface tension of 65 mN/m or greater), the transparent conductive layer disclosed by

Abe et al and Nakamura et al do not inherently have the specified surface tension (65 mN/m or greater) as described in Comparative Example 3 in the present application.

The Examiner considers that it would have been obvious to a person of ordinary skill in the art to provide a surface tension of 35-60 dyne/cm to the transparent conductive film of Abe to provide a strong adhesion between the adjacent layers as taught by Ohya.

Contrary to the Examiner's position, though, the kinds of adjacent objects and their shape disclosed in Ohya differs from the present invention, so Applicants believe it is not obvious to one of ordinary skill in the art to find the specific surface tension of 65 mN/m or greater as the transparent conductive layer to obtain excellent adhesion between the transparent conductive layer and the porous semiconductor layer based on Abe in view of Ohya et al.

Moreover, as the effect of the present invention, the photogenerating efficiency with time after fabrication of the dye-sensitized solar cell is improved as discussed above when the requirements of the present invention are satisfied.

In particular, Applicants wish to emphasize that the greater surface tension and the difference of the shape of the adjacent layer in the present invention as compared with Ohya are reasons why the present invention is not obvious over the cited art.

In this regard, as noted above, *the present invention requires that the transparent conductive layer has a surface tension of 65 mN/m or greater, while Ohya only discloses a transparent conductive thin film having a surface tension of 35 to 60 dyne/cm.* Indeed, it is submitted that Ohya **teaches away** from the present invention by discloses in the paragraph bridging columns 8-9 that when the transparent conductive thin film has a surface tension of greater than 60 dyne/cm, it results in an increase in the amount of adsorbed water such as

moisture on the transparent conductive thin film, which gives insufficient adhesion properties to silver paste.

Accordingly, Applicants submit that the present invention is not obvious over the cited art combinations, and withdrawal of these rejections is respectfully requested.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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Respectfully submitted,

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Date: March 9, 2011